Application Note

- AC30 - Common DC bus generator

HA504827 Issue A

PDQ version 3.6.26.3

Application note according to the PDQ projects :

“DC generator Trq Ctrl.project”

and “DC generator Trq Ctrl autostart.project”

(ANaveau@parker.com for more info)

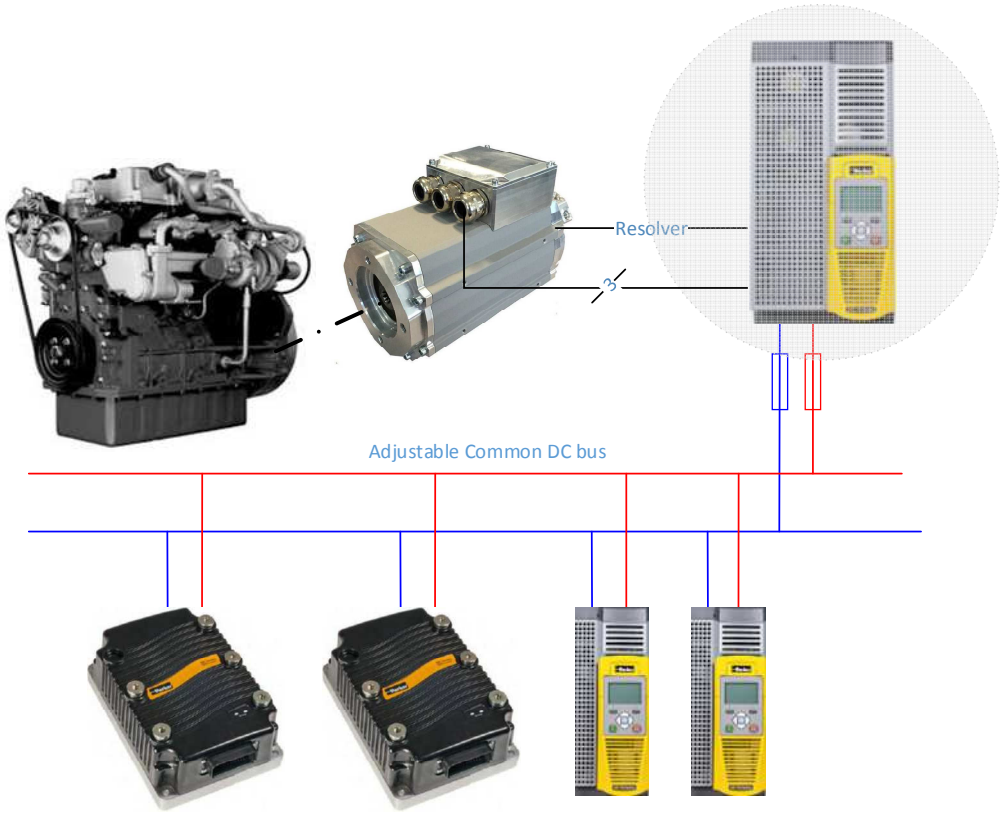
COMMON DC BUS GENERATOR

1: DESCRIPTION

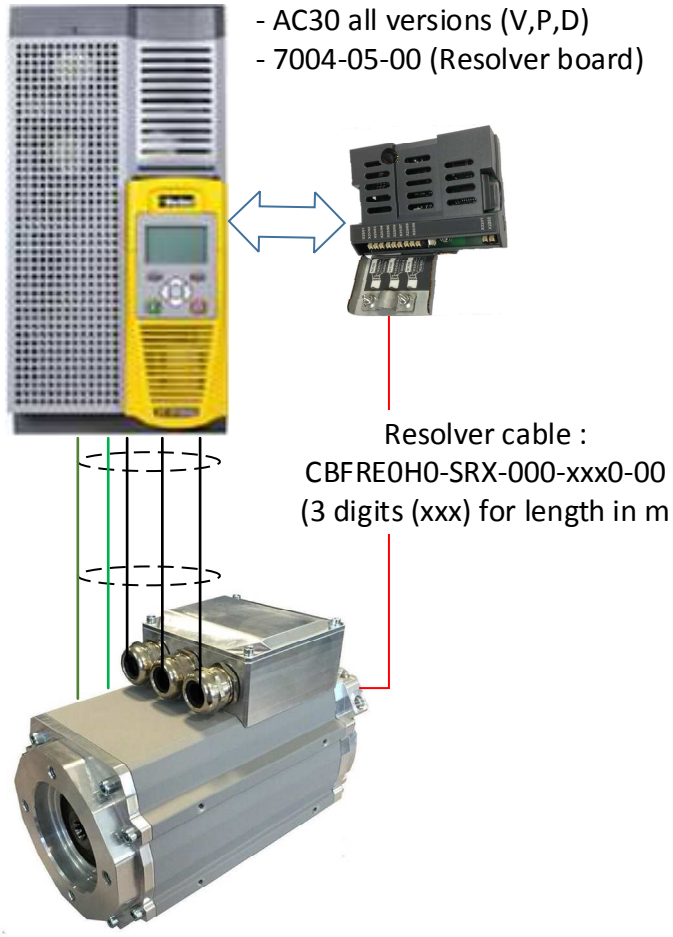
The aim of this application note is to show how to program an AC30 in DC Bus control.
A Diesel engine or other rotational power source coupled to a PMAC motor (parker GVM for instance) is used to power up a DC bus at controlled value. The DC bus may be seen as a battery simulator.

The DC bus can then be connected to other DC fed drives or other devices requiring DC supply.

Typically for mobile applications: train, bus, Battery simulator…



2: CONFIGURATION



1. Hardware

AC30 series, up to 450 kW, all versions

Example made with:

- 740-4D0010-BN-0S-0000 (10A - 400V)
- 30D-2S-00000, (FW 2.15.2)
- 7004-05-00 (Resolver and Thermistance Option)

2. Software

- AC30V with FW 1.15.2 and above
- AC30 P/D : FW 2.13 and above

3: SEQUENCES / CONDITIONS

1. The selected motor for this application must be a PMAC motor. By concept, this motor will behave as a generator when coupled to a rotational power source, such as a Diesel engine for instance.

The 3 phases of the motor will supply the DC link thru the diodes of the output bridge of the drive.
The DC link level will then be approximately proportional to the speed of the engine:

$$DC\ Volt\ (Vdc) = \ Ke\ (V/1000rpm) * (n\ (rpm)/1000) * \ 1{,}35$$

For example : Ke = 88,9V/1000rpm, n = 4000rpm ➔ DC Volt ~ 480Vdc

2. The DC volt generated by the Diesel must be higher than the *Under-voltage threshold* of the drive. (420V for an AC30). If the speed of the generator is too low according to the Ke of the motor, the sequence cannot be started.

$$n\ (rpm) = \frac{(420 * 1000)}{Ke\ (V/1000rpm) * 1{,}35}$$

3. To make the sequence of this application note working properly, the motor has to be powered in position direction. This does not mean that the direction has to be clockwise (when looking at the shaft end), this means that the drive must see a POSITIVE direction accordingly to the Diesel direction. The *Pos Fbk Alignment* settings may have to be adjusted prior to start the application

⇨ **Parameters : Motor Control : Pos Fbk Alignment**

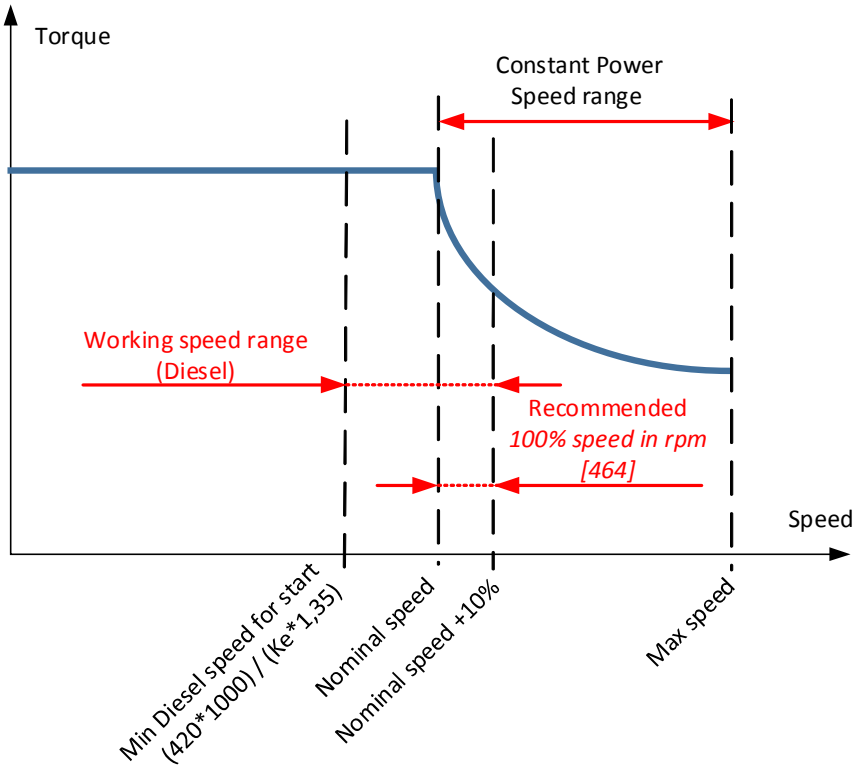
NOTE: If possible, it is recommended to run the motor first separately (without Diesel) in speed control, powered by the drive (standard motor control) and check that the control is fine. (refer to §PMAC settings in the AC30 manual).

4. The nominal speed of the application (*100% Speed in rpm* [464]) must be greater or equal to the Diesel max speed. If the Diesel speed goes higher than 110% of speed defined in [464], the drive would limit the speed and control loop would not be capable to maintain the DC bus.

   In order to get the highest efficiency of the system, it is recommended to run the PMAC motor (= Diesel speed) at his nominal speed or slightly higher (~10%), in the constant power area.

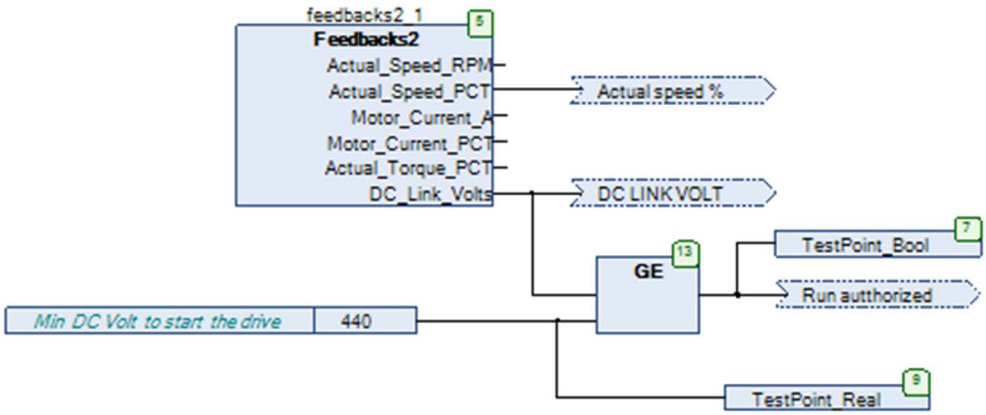
5. At start, the DC Volt setpoint will be ramped from Actual DC volt level (see point 2. Above) to the DC Volt required (600Vdc in the example attached).
   This DC volt setpoint can be modified from about 500V to 700V, even dynamically.

PMAC motor specs : Working speed range



4 : PDD / PDQ Project

1. Checking the starting conditions:
   - Run the Diesel at starting speed accordingly to calculation in §3.1 above.
   - Check that actual DC bus is greater or equal to 440Vdc ➔ *Run authorization* bit raised to the controller or internally (this example).

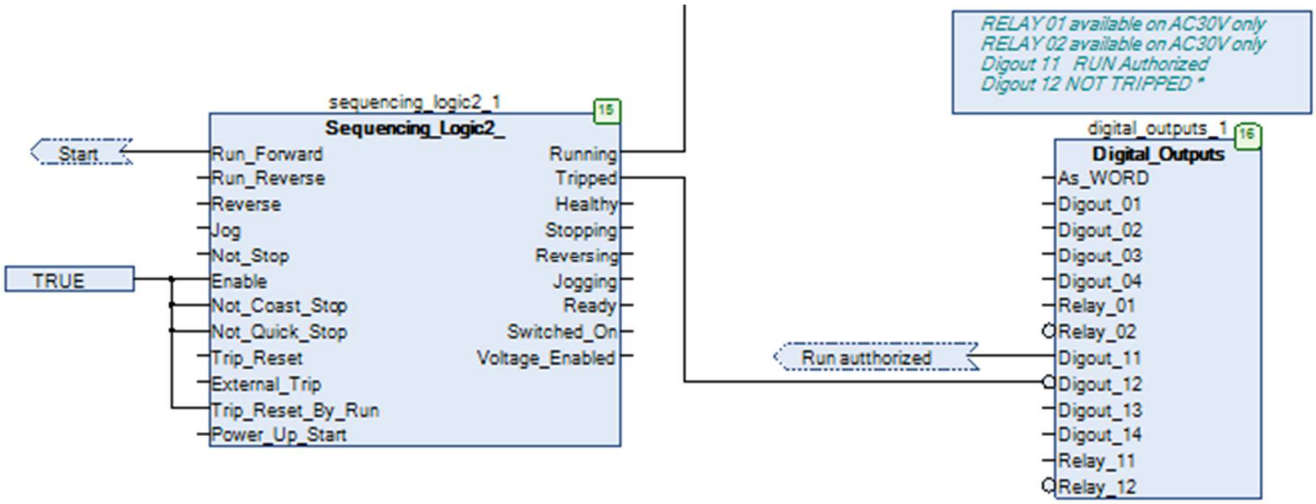


2. Start / Stop sequence

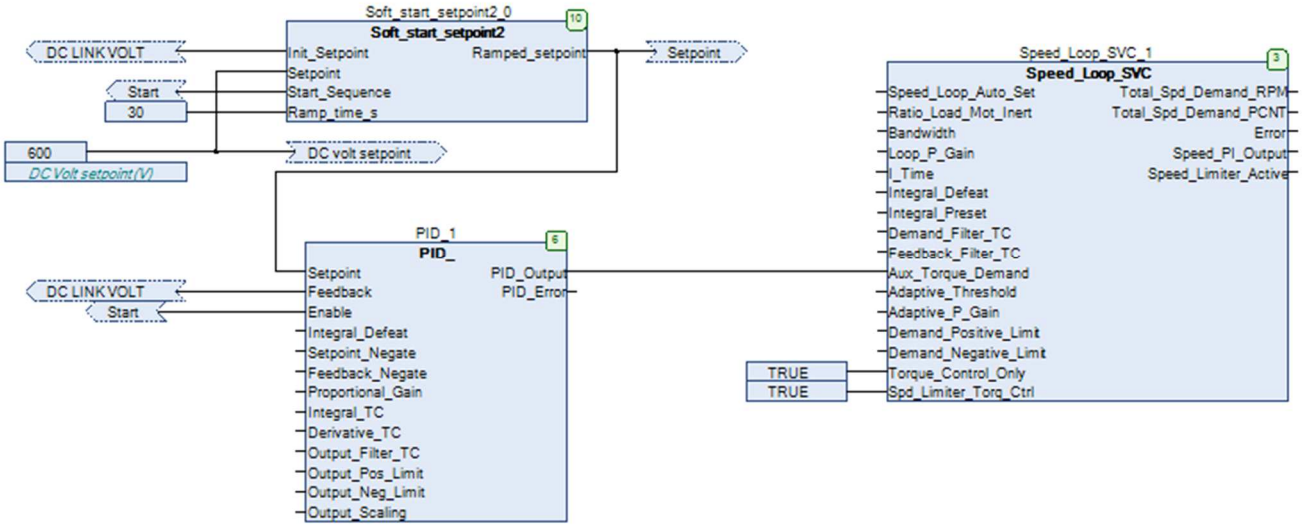
Sequencing logic 2 :: Run Forward

Stop method is set to “Disable Voltage” to avoid ramping when stopping the drive (this would cause an overvoltage trip) : The drive is instantaneously disabled

[1257] Setup : Motor Control : Control and Type : Seq Stop Method SVC = Disable Voltage



3. PID Control



The *Soft Start Setpoint* FB allows the PID setpoint to be ramped from starting value (~480V in the example) to DC Volt setpoint (600V), preventing from current surges.

The *Speed Loop SVC* FB is set in Torque Control Only. The PID output is directly linked to the Torque setpoint.

The AC30 allows the speed limit (to +/-110% of *100% Speed in rpm* [464]) despite the speed loop in “disconnected”. This will prevent the drive to reach an excessive speed in case the Diesel stops in an uncontrolled manner.

This function also adjusts the speed demand to the feedback. As a result, it is not required to disable the *Speed Error Trip* (ID 41)

[1780] Parameters : Motor Control : Spd Loop Settings : Spd Limiter Torq Ctrl = True

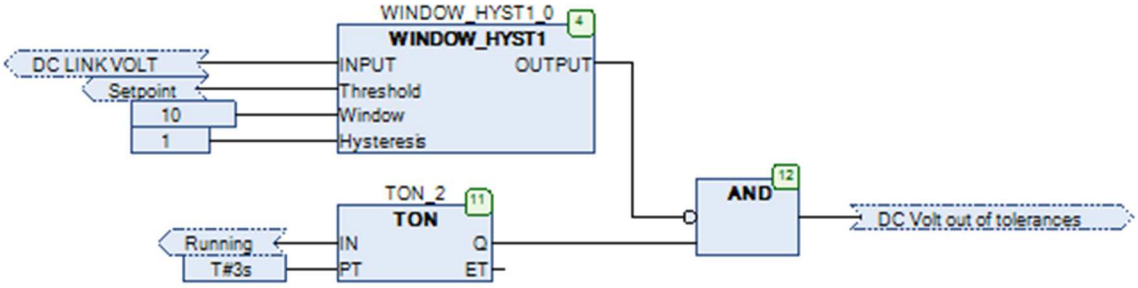
PID Settings :

PID : Prop Gain	0.6
PID : Integral TC	500ms
PID : Derivative TC	50ms
PID : Output Filter TC	100ms
PID : Output Scaling	-1
PID : Output Pos Limit	100
PID : Output Neg Limit	-100

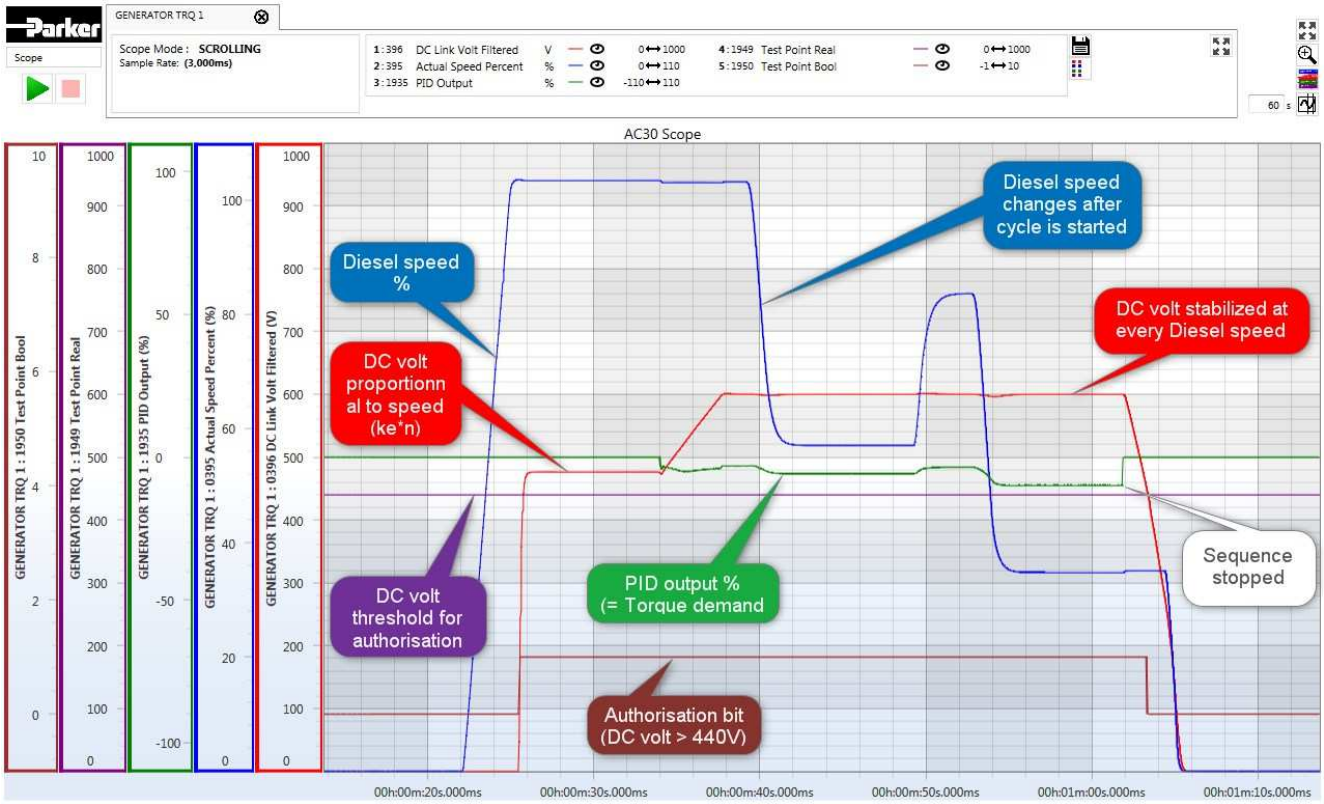
Those PID settings are working well for the given example. They obviously depend of many parameters, mainly the capacitor bank installed on the common DC link and the behavior of other drives / loads powered.

4. DC volt checking

The DC volt level is dynamically controlled to interrupt the sequence or just inform the machine controller to adapt the cycle. A window of +/-10V around the setpoint is allowed in this example.



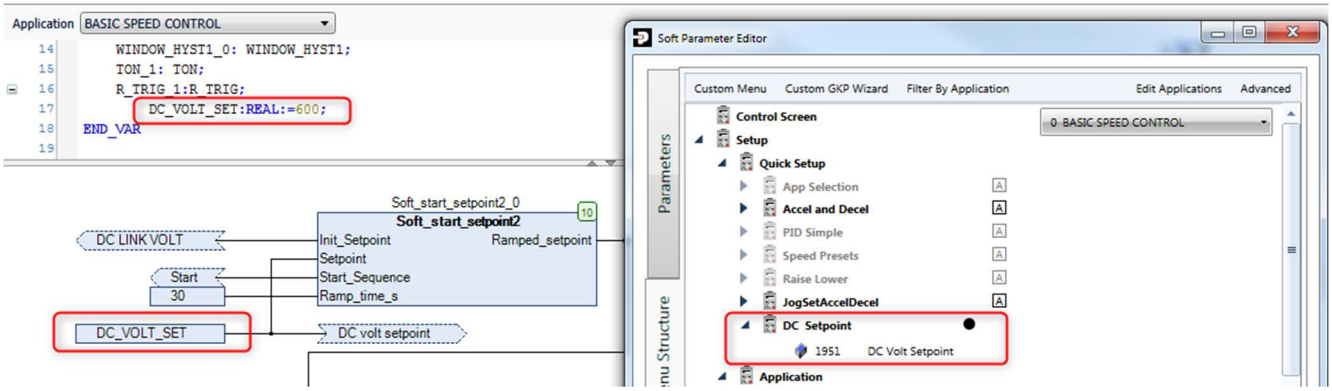
5: Scope records



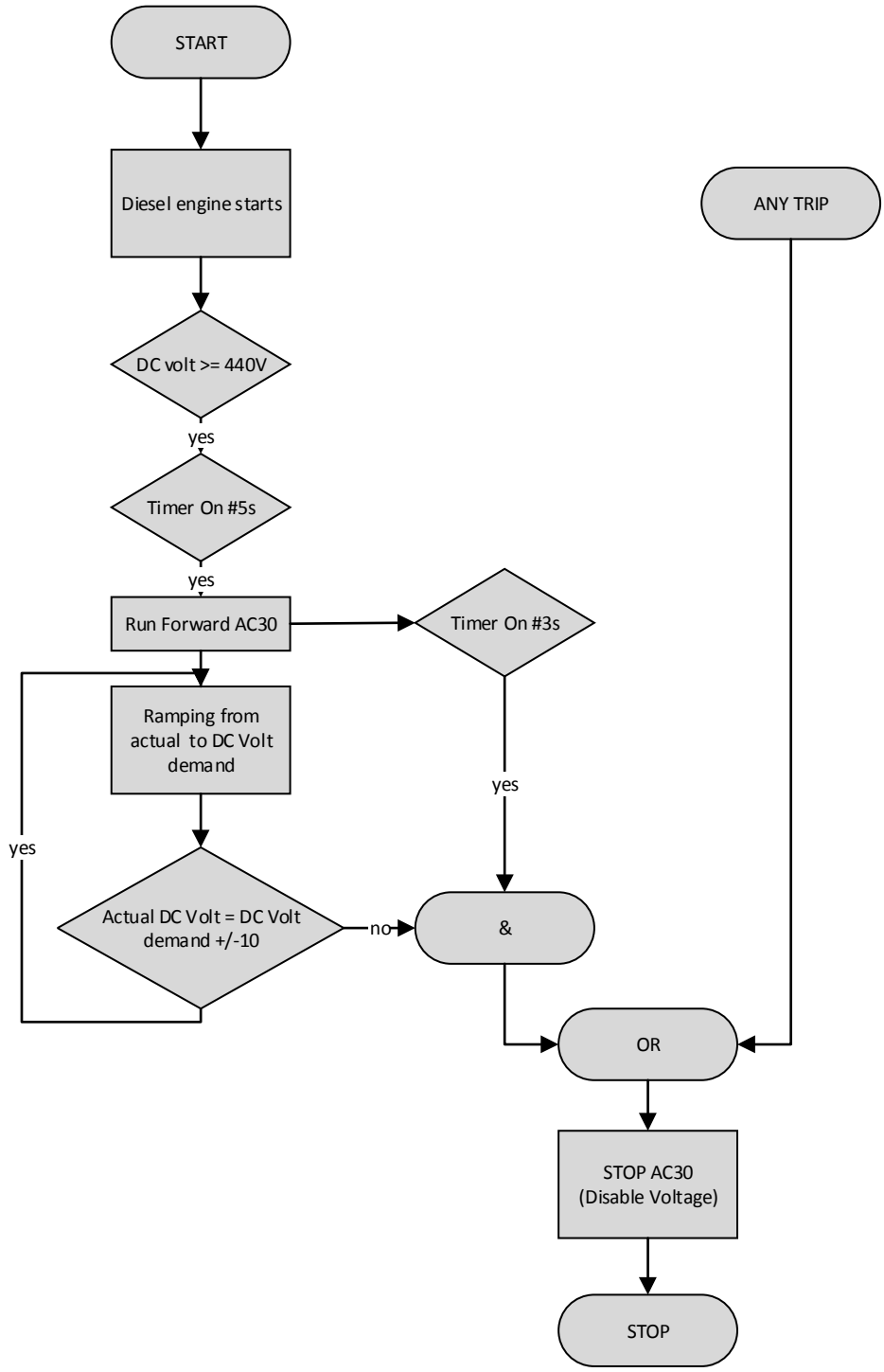
6: Option: Auto Start / Stop

It may be interesting to start the sequence automatically when the Diesel engine starts. See example “DC generator trq Ctrl autostart.project”.
The AC30 auto starts after a short timer (5s) when the min DC Volt level is reached. The DC volt demand is then automatically controlled just like previous example. The drive will stop automatically if the DC volt is out of tolerances (DC Volt demand +/-10V); e.g. when the Diesel speed stops.

In this example, The DC Volt demand has been added in the GKP menu for easy change. Default value is 600V, range between 500 and 700V.



Sequencing:


START
Diesel engine starts
DC volt >= 440V
yes
Timer On #5s
yes
Run Forward AC30
Timer On #3s
Ramping from actual to DC Volt demand
yes
yes
Actual DC Volt = DC Volt demand +/-10
no
&
ANY TRIP
OR
STOP AC30 (Disable Voltage)
STOP